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Variation in total length of fresh and preserved brown shrimp (Penaeus aztecus Ives) measured by two methods. Progr. Fish-Cult. (8 MS. pp.).

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Library

Renovation of the library quarters became necessary during the year to relieve crowded conditions that resulted from the general increase in the size of the library collection. Acquisition of an adjoining room for office facilities released space for the expansion of the shelving and reading room areas within the library. This project is partially complete.

We added to the library collection about 500 volumes of books and journals, and over 4,100 reprints, reports, and miscellaneous publications during fiscal year 1969. The library contributed to the Interior Union List of Serials scheduled for publication in 1969. We continued to issue the biweekly list of current acquisitions, which is sent to the Laboratory staff and other laboratories.

In addition to the Laboratory staff, the library served an increasing number of students and faculty members of area universities and laboratories. Various individuals from industrial firms and other institutions used the specialized collection.

Table 1 gives the statistical summary of the library collection for fiscal year 1969.

Museum

In operation since August 1965, the museum maintains valuable collections of biological and botanical specimens. Most specimens are from the Gulf of Mexico, principally from Texas and Florida. Others, however, are from such areas as the Bahamas, the Galapagos Islands, New Zealand, the Philippines, and the Virgin Islands.

Many specimens indigenous to this area are arranged systematically and displayed for educational use (fig. 1). Information provided with many of the species includes common and scientific names, and location, date, and depth of capture. This portion of the collection has been of considerable interest to educational groups.

Several thousand samples of plankton are maintained for study and display. During the past year, aliquots of about 480 samples were processed and shipped to the BCF Biological Laboratory in Beaufort, N.C., where they will be used in menhaden studies.

Public Relations

This year nearly 1,900 people visited our Laboratory. Represented in this group were Federal and State agencies, private industries, foreign countries, universities, high schools, and grade schools. In response to this interest, we provided Laboratory tours, field trips, training sessions, private consultations, and lectures.

Of the 1,900 visitors, 22 were from 12 foreign countries. These countries and the number of representatives are listed below:

Argentina (1)	Malaysia (1)
Australia (2)	Mexico (8)
Chile (1)	Norway (2)
East Pakistan (2)	Philippines (1)
Greece (1)	South Africa (1)
Japan (1)	Thailand (1)

SHRIMP BIOLOGY (MARICULTURE) PROGRAM

During the past year, brown shrimp spawned in the laboratory on five different occasions and pink and white shrimp once. With the resulting larvae, we completed two feeding experiments, two salinity experiments, and an experiment to assess the effects of salinity and EDTA (ethylenediaminetetraacetate) on larval development. Postlarvae were supplied to 10 nonprofit research organizations. In addition, cultures of diatoms and instructions for their culture were supplied to seven organizations.

We completed two experiments to screen various fish and animal feeds as possible food for shrimp in ponds. In all, the 11 different

Table 1.--Statistical summary of library collection, Biological Laboratory, Galveston, Tex., 1968-69

Item	On hand June 30, 1968	Additions fiscal year 1969	On hand June 30, 1969
	Number	Number	Number
Books	3,295	141	3,436
Journals (bound)	726	107	833
Journals (Unbound)	2,274	233	2,507
Reprints	4,415	411	4,826
Publications from State and foreign offices	17,020	3,661	20,681
Other	1,782	89	1,871
Total items	29,512	4,642	34,154

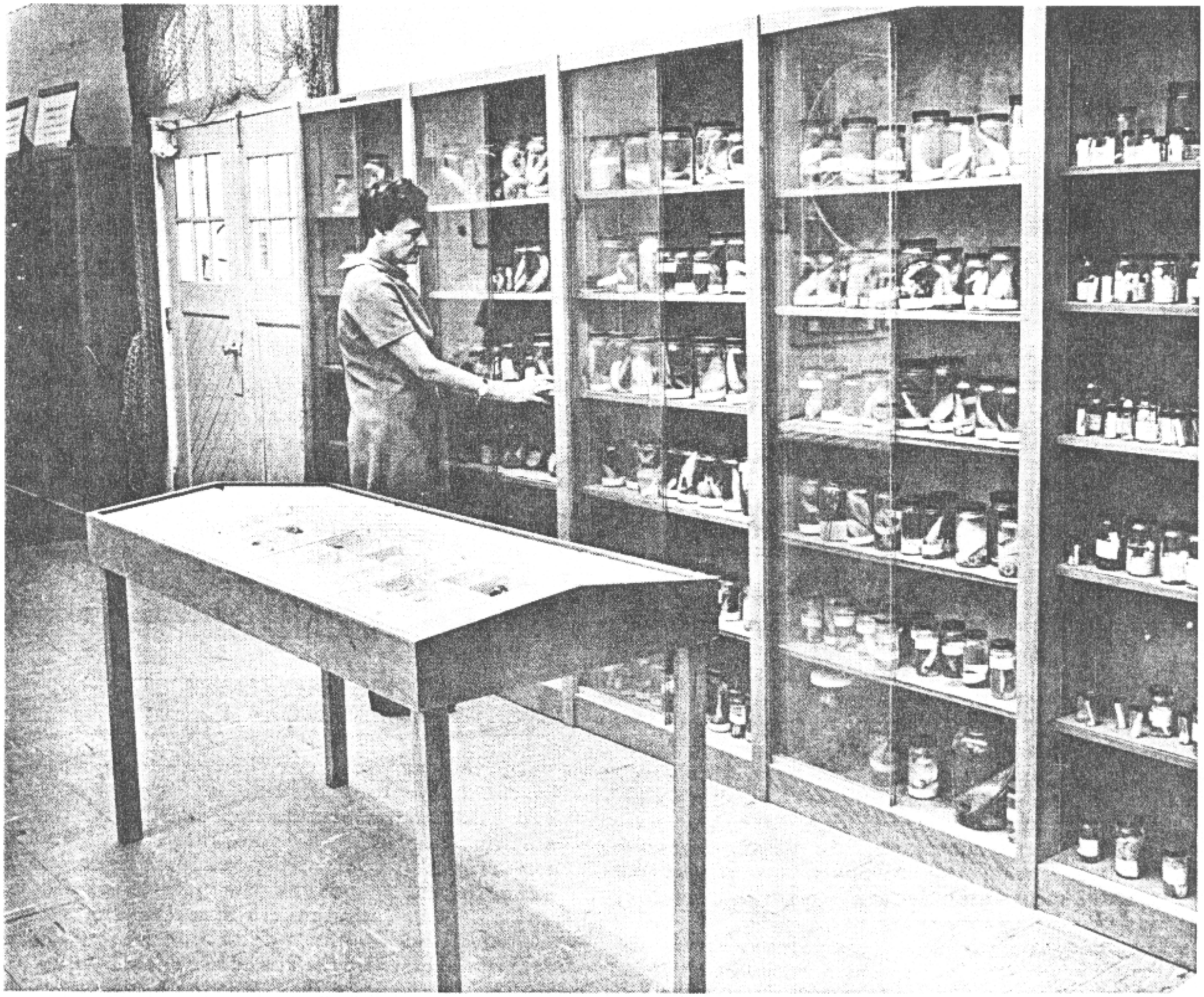

Figure 1.--Biological and botanical specimens in the museum interest our many visitors.

foods we used included 9 commercial foods and 2 gelatin-bound formulations that we prepared. Concurrent studies on food particle size suggest that juvenile shrimp prefer large food particles which they can hold and break pieces from rather than small particles that can be ingested whole.

We also directed research toward the problem of bringing penaeid shrimp into spawning condition in the laboratory. Adult shrimp, held in four ponds and several large tanks inside the laboratory, were fed different diets and observed for sexual development. Only males in ponds showed apparent signs (externally) of sexual maturation.

We added several new research facilities and modified others this past year. Twelve concrete tanks, 3 m. long, 1 m. wide, and 1 m. deep (10 ft. by 3 ft. by 3 ft.) were constructed adjacent to our East Lagoon Laboratory. These tanks are connected to the Laboratory's sea-water system and are covered by an open-sided shed roofed with fiberglass. A heat exchanger was incorporated into the sea-water system at Fort Crockett. A 7,700-liter (2,100-gallon) tank, six 1,850-liter (500-gallon) tanks, and equipment for regulating water temperature in the tanks were installed in the East Lagoon Laboratory. We now have a pellet maker that we can use to make experimental foods in sufficient quantity for large-scale experimentation. We made many modifications to facilitate handling and care of larval shrimp, and installed a light room for the mass culture of algae. In addition, a contract was let to the U.S. Army Corps of Engineers for a design to convert the basement of a demolished building into a recirculating sea-water system.

Personnel in the Florida Bay Ecology Studies Project prepared manuscripts that summarized the results of past research. Following the recommendation of the budget review committee, we terminated this project at the end of the year and transferred the personnel to the Bureau's TABL (Tropical Atlantic Biological Laboratory), Miami, Fla.

Harry L. Cook, Program Leader

Larval Culture

We concentrated during the year on determining the physiological requirements of shrimp larvae and developing a prototype hatchery for the culture of larval shrimp. To supply food for the larval shrimp, we also spent considerable time developing a method to grow mass cultures of algae in artificial media.

Larval physiology.--As the result of feeding experiments completed during the year, we concluded that Thalassiosira sp. is the most suitable alga of those tested as food for the larval shrimp. Other algae tested were Skeletonema costatum, Cerataulina sp., Cyclotella nana, and Isochrysis galbana. Table 2 shows the results of one experiment in which brown shrimp protozoeae were fed Thalassiosira. Further analysis of these data showed that protozoeae I survived best when Thalassiosira was supplied at rates of 180,000 to 190,000 cells per larva per day; protozoeae II at rates of 240,000 to 290,000 cells; and protozoeae III at 340,000 to 370,000 cells. In another experiment myses of brown shrimp were fed Artemia nauplii and Thalassiosira. Those animals fed a mixture of Artemia and algae grew faster than those fed only Artemia, but survival was similar except when the numbers of Artemia nauplii supplied were too low.

Table 2.--Concentrations of Thalassiosira supporting the best survival of brown shrimp protozoeae, Biological Laboratory, Galveston, Tex.

Larval stage	Shrimp	Thalassiosira
	Number per liter	Number per ml. (X 1,000)
Protozoea I[1].....	133	30
	167	40
	266	50
	333	60
Protozoea II[2]....	133	40
	167	50
	266	60
Protozoea III[3]...	133	50
	167	60

[1] First-stage protozoea.
[2] Second-stage protozoea.
[3] Third-stage protozoea.

We performed two experiments to determine the effects of salinity on the growth and survival of larvae of brown shrimp. All larval stages in these experiments were held at salinities of 24, 28, 30, and 34 p.p.t. (parts per thousand). EDTA was added to the water in which a portion of the shrimp were held. Survival was best at 28 and 30 p.p.t. Variable survival at 34 p.p.t. indicated that the salinity level probably was near the upper limits of tolerance. Larvae survived well at 24 p.p.t. with EDTA, but they suffered complete mortalities when EDTA was absent. EDTA benefited all stages of larvae at all salinities.

A further test of the effect of EDTA involved the use of a synthetic sea water. Protozoeae III were placed in synthetic sea water (30 p.p.t.) with and without EDTA. Survival was similar in the two groups, but the larvae developed fastest in the water with EDTA.

Mass culture.--Work was directed primarily to the development of a prototype shrimp hatchery. We modified equipment, incorporated